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ABSTRACT

A longitudinal study was conducted to evaluate the U.S. Employment Service's Specific Aptitude Test Battery (SATB) for plumber/pipe fitter from three aspects: technical adequacy of the research; fairness to minorities; and usefulness in the selection of individuals for training as plumber/pipe fitter apprentices. The validation sample consisted of 253 apprentices (including sixty-nine minority group members) in their first year of apprenticeship during 1974-1976 in eight states and the District of Columbia. The tests for this sample were taken from the General Aptitude Test Battery, while on-the-job competency was gauged by supervisors' ratings, and ability to perform five categories of related course work was measured by instructors' ratings. A cross-validation sample was also used, based on data collected in 1953-1954 from 322 apprentices in Texas (the minority group composition of which was unknown). Criterion for this group consisted of category ratings for a combination of job performance and school achievement. SATB was found (1) to be useful in the selection of apprentices; (2) to be fair to minorities; and (3) to meet all criteria for validity using the more recent sample and for cross-validity based on the prior test sample. (The appendixes include the following: statistics for black and nonminority subgroups of the validation sample; descriptive rating scales for employers and instructors; and a job description and the first-year apprenticeship curriculum for plumbers/pipe fitters.) (ELG)

DEVELOPMENT OF USES SPECIFIC APTITUDE TEST BATTERY

For

PLUMBER (const.) 862.381-030
PIPE FITTER (const.) 862.381-018

S-61R78

Developed in Cooperation with the
California, Colorado, District of Columbia,
Florida, Iowa, Michigan, Missouri, Pennsylvania, and Texas
State (or District) Employment Services

Analysis and Report

by

Western Test Development Field Center
Salt Lake City, Utah

U.S. DEPARTMENT OF LABOR

Employment and Training Administration
United States Employment Service

1978

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National

The National Joint Plumbing Apprentice and Journeymen Training Committee

The National Joint Steamfitter-Pipe Fitter Apprenticeship Committee

The United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada

Local

Joint Apprentice and Training Committees

North

Des Moines, Iowa Local No. 33 (Plumber/Pipe Fitters)

Ann Arbor, Michigan Local No. 190 (Plumber/Pipe Fitters)

Kansas City, Missouri Local No. 533 (Pipe Fitters)
Local No. 8 (Plumbers)

Latrobe, Pennsylvania Local No. 354 (Plumber/Pipe Fitters)

South

District of Columbia Local No. 5 (Plumbers)
Local No. 602 (Pipe Fitters)

Jacksonville, Florida Local No. 234 (Plumber/Pipe Fitters)

Miami, Florida Local No. 519 (Plumbers)

San Antonio, Texas Local No. 142 (Plumber/Pipe Fitters)

West

San Diego, California Local No. 230 (Plumber/Pipe Fitters)

Denver, Colorado Local No. 3 (Plumbers)
Local No. 208 (Pipe Fitters)

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DEVELOPMENT OF USES SPECIFIC APTITUDE TEST BATTERY S-61R78

for

PLUMBER (const.) 862.381-030
PIPE FITTER (const.) 862.381-018

SUMMARY

This report is designed to provide the information required to evaluate the Specific Aptitude Test Battery (SATB) for Plumber/Pipe Fitter from three points of view: (1) technical adequacy of the research; (2) fairness to minorities; and (3) usefulness of the battery to Employment Service staff, apprentice selection committees, and employers in selecting individuals for training as Plumbers/Pipe Fitters.

Research demonstrated a statistically significant and useful relationship between proficiency as Plumber/Pipe Fitter Apprentice and the following Specific Aptitude Test Battery:

Aptitudes	Cutting Scores
V - Verbal Aptitude	90
P - Form Perception	95
M - Manual Dexterity	85

The validation sample for this SATB consists of 253 Plumber/Pipe Fitter apprentices (including 46 Blacks). Selection was through the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the U.S. and Canada and the National Joint Plumbing Apprentice and Journeymen Training Committee. Selection was limited to individuals in their first year of apprenticeship training. Data were collected from 8 States and the District of Columbia during 1974-1976. The tests used were those of the General Aptitude Test Battery (GATB). On-the-job proficiency of apprentices working in the Plumber/Pipe Fitter construction industry was gauged by supervisors' ratings; ability to perform related course work was determined by instructors' ratings of five major categories of course work.

A second sample confirmed or cross-validated the SATB. This sample consisted of 322 apprenticed Plumbers and Pipe Fitters. The criterion consisted of broad category ratings based on a combination of job performance and school achievement. These ratings were made by the Area Joint Committee of Plumbers and Pipe Fitters and school coordinators. The data were collected in 1953-54. The SATB did not cross-validate with data collected in 1953-54 on a Texas sample of 89 journeymen Plumbers and Pipe Fitters.

No evidence of differences in validity for Blacks and nonminorities was found; the SATB was found to be fair to Blacks and nonminorities using several definitions of fairness. Additional information may be found in the Validity of the Battery section and in Appendix 1.

This SATB better meets standards for an acceptable preemployment test than prior SATB's. The original SATB (B-304) was found to be valid for the total validation sample and the nonminority subgroup but not for the Black subgroup. The S-61R battery, developed in 1970, cross-validated with the total validation sample but not with the nonminority and Black subgroups.

S-61R78 can be expected to produce a useful increase in the proportion of highly proficient workers. When the SATB was applied to the validation sample, composed of first year apprentices, an increase from 67% to 80% in the proportion of highly proficient apprentices was found. Similar results were found for the cross-validation sample.

PROCEDURE

A longitudinal design was used for the validation study; GATB test data were collected from apprenticeship applicants as soon as they were accepted for the program. Job performance criterion data were not collected until subjects had completed at least one year or dropped out of the program. Instructors' ratings were obtained for each member's performance in each of six curriculum areas periodically while the training was in progress. Local Joint Apprenticeship and Training Committee (JATC) representatives and State agency test research analysts collected these data from March 1975 to September 1976.

Job Analysis

A current job description for Plumber/Pipe Fitter was provided to all participating States. JATC's and the apprentices' supervisors were consulted to ascertain that all apprentices were doing the same work. The job description shown in Appendix 4 is the result of this action and may be used to provide information on the applicability of the test battery resulting from this research.

Each job duty was rated for frequency of performance, percentage of time spent, and level of difficulty as part of the job analysis. Critical job duties were identified on the basis of these ratings.

At least one analyst at each location rated the aptitudes as irrelevant, important, or critical to performance of the job duties at that location. A synthesis of these ratings and their rationale follows:

G - General Learning Ability	Required to interpret blueprints, job specifications, and building codes; to comprehend safety codes; to plan and coordinate work with other crafts; to learn properties of a variety of metal and nonmetal pipes and methods of joining, threading and bending these pipes.
N - Numerical Aptitude	Required to estimate quantities of material needed; to determine length and size of pipe; to measure placement of pipes, drains, controls and fixtures.
S - Spatial Aptitude	Required to visualize three-dimensional installations from blueprints, specifications and instructions.

P - Form Perception	Required to recognize fittings, pipe sizes, tools and materials; and to recognize and interpret symbols on blueprints and specifications.
M - Manual Dexterity	Required to use hands and wrists in placing and turning motions to use hand, power and power-actuated tools to cut, bend, fabricate and install pipe systems.

Experimental Test Battery

The experimental test battery for the validation sample consisted of all 12 tests of the GATB, B-1002. All parts of Form B-1001 were administered to the cross-validation sample. B-1001 scores were converted to equivalent B-1002 scores. Information on the composition and developmental research of the GATB may be found in the Manual for the General Aptitude Test Battery, Section III, Development, available from the Government Printing Office.

Validation Sample Description

The validation sample consisted of 253 Plumber/Pipe Fitter apprentices employed at various locations in the North, South, and West (see ACKNOWLEDGMENT). A total of 69 were minority group members (46 Blacks, 16 Spanish Surnamed, 4 American Indians, 1 Oriental, and 2 French Canadians) and 184 were nonminority group members. All of the 253 subjects were male. The means and standard deviations for age and education of sample members are shown in Table 1.

All subjects except dropouts had been in the Plumber/Pipe Fitter apprenticeship program for at least a year. No sample members were test-selected. To have been accepted into the program, applicants had to be 16 years old and have graduated from high school or passed the GED hi h school equivalency tests.

Descriptive statistics for Black and nonminority subgroups are shown in Appendix 1.

Cross-validation Sample Description

The cross-validation sample was obtained in 1953-54 prior to the requirements of providing minority group information. Therefore, ethnic group composition is unknown. The sample consisted of 322 male workers apprenticed as Plumbers and Pipe Fitters in various cities in Texas. The means and standard deviations of age, education and experience of sample members are shown in Table 1a.

Criteria for Validation Study

The criteria for the validation study consisted of combined supervisory ratings and the sum of instructors' ratings on 5 of the 6 curriculum courses. Instructors' ratings for Course A--Safety were not used because of incomplete data. Test scores were also collected for 15 tests covering subject matter included in the 6 standard curriculum courses of related apprenticeship training. These test scores were not used as a criterion because most apprentices achieved an overall score of satisfactory for the 15 tests.

Supervisory ratings were obtained by means of personal visits of JATC coordinators who explained the rating procedure to the supervisor. Each subject was rated twice by a first line supervisor with an interval of two weeks between ratings, or once each by a first line and a second line supervisor. Since sample members' aptitude scores are confidential, supervisors had no knowledge of apprentices' aptitude test scores. Thus, the possibility of these scores affecting ratings did not exist.

A descriptive rating scale was used. The scale (see Appendix 2) consists of six items. Five of these items cover different aspects of job performance. The sixth is a global item on the Plumber/Pipe Fitter's "all-around" ability. Each item has five alternative responses corresponding to different degrees of job proficiency. For the purpose of scoring items, weights of 1 to 5 were assigned to the responses. The total score on the rating scale is the sum of the weights for the six items. The possible range for each rating is 6-30 or 12-60 for combined ratings.

A review of the job description indicated that the items covered by the rating scale were directly related to important aspects of job duties performed by Plumbers/Pipe Fitters.

A - Quantity of work: A Plumber/Pipe Fitter must work rapidly and efficiently in order to meet standards of accomplishment set for competitive contract work.

B - Quality of work: A Plumber/Pipe Fitter's work must be of high quality to meet job specifications, local building codes and safety requirements as determined by the Occupational Safety Act of 1970.

C - Accuracy of work: A Plumber/Pipe Fitter must install all piping systems according to government requirements, local codes and job specifications based on a study of building plans and working drawings.

D - Job knowledge: A Plumber/Pipe Fitter must have knowledge of materials used to install or repair systems for power generating facilities, heating, refrigeration, water supply, storm drainage, sanitary and industrial facilities.

E - Job versatility: A Plumber/Pipe Fitter must be capable of performing a wide variety of installing and repairing tasks with a wide variety of materials under widely varying conditions.

F - "All-around" job ability: A Plumber/Pipe Fitter's value involves a combination of aspects of job performance listed above.

A reliability coefficient of .56 was obtained between the two different supervisory ratings. Although this figure is considerably lower than that obtained for most S/ studies, the reliability of the combination of the two supervisor ratings is e- imated by the Spearman-Brown formula to be .72. Therefore, the final job performance criterion score consists of the combined scores of the two ratings. The possible range for the combined scores is 12-60. The actual range for the total sample is 18-58. The mean is 39.7 with a standard deviation of 6.3. The relationship between the job performance criterion and age and education is shown in Table 1.

Instructors' ratings were obtained from instructors who taught the various curriculum courses. Each apprentice was rated once by the instructor for each of the five training courses. Courses B and C are related theory courses, and Courses D-F are related practical or manipulative courses (see Appendix 5). Instructors had no knowledge of apprentices' aptitude test scores, and so these scores had no effect on curriculum course ratings.

A descriptive rating scale for apprentices was used to obtain instructors' ratings. The scale (see Appendix 3) consists of six items. Five of these items

cover different aspects of training. The sixth is a global item on "all-around" training ability. Each item has five alternative responses corresponding to different degrees of training proficiency. Scoring weights of 1 to 5 were assigned to these responses. The total score on the rating scale is the sum of the weights for the six items. Possible ranges for instructors' ratings are 6-30 for each course rating and 30-150 for combined ratings (Courses B-F).

A review of the course outline for Plumber/Pipe Fitter apprentices indicated that the items covered by the rating scale were directly related to important aspects of job related training.

A - Quantity: An apprentice must meet standards of accomplishment in learning the skills and knowledge required in the training program.

B - Quality: An apprentice must perform written assignments and examinations carefully and completely and demonstrate the ability to meet exacting specifications in performing practical manipulative exercises.

C - Quickness in learning instructional units: An apprentice must demonstrate the ability to grasp important concepts and learn manipulative skills quickly to be successful in job related training.

D - Skill in use of equipment: An apprentice must demonstrate knowledge and skill in making safe, proper and efficient use of equipment in job related training.

E - Variety of duties performed efficiently: An apprentice must acquire a wide variety of knowledge and skills to complete successfully formal job related training.

F - General performance: Successful completion of the formal training phase of the Plumber/Pipe Fitter apprenticeship involves a combination of the above aspects of learning ability.

Reliability of instructors' ratings is unknown because only one rating was obtained for each of the five courses. Course work outlines were standard throughout the nation, having been coordinated through the National JATC. The actual range for the total sample is 44-144. The mean is 102.7 with a standard deviation of 17.5. The relationship between the related training criterion and age and education is shown in Table 1.

The correlation between the combined supervisory ratings and the sum of the five instructor ratings is .44. Each of the two criteria is designed to measure a separate aspect of apprentice performance. There is reason to believe that the two criteria do, to some extent, measure different aspects of performance. The fact that differential measurement is indicated and each criterion correlates significantly with most GATB aptitudes justifies use of a multiple-hurdle criterion.

For the purpose of the analysis, the criterion distribution was dichotomized so as to include, as nearly as possible, one-third in the low criterion group and two-thirds in the high. This procedure is standard for SATB studies.

Because a multiple-hurdle was designated for the study, analysts were required to determine appropriate cutting scores for the separate job-performance and course-work criteria. A cutting score of 36 for the job performance criterion

together with 88 for the course work criterion placed 33% of the total group, 26% of the nonminority group, and 63% of the Blacks in the low criterion group.

Criterion for Cross-validation Study

The criterion for the cross-validation sample consisted of broad category ratings based on a combination of job performance and school achievement. These ratings were made by the Area Joint Committee of Plumbers and Pipe Fitters and school coordinators. For computational purposes, the ratings were converted to quantitative values of 61, 50, and 39 for the above average, average and below average groups respectively. The relationship between the criterion and age, education and experience is shown in Table Ia.

TABLE 1

Means, Standard Deviations (SD), and Pearson Product-Moment Correlations with Instructor Ratings (r_1) and Supervisor Ratings (r_2) for Age and Education

Validation Sample
N=253

	Mean	SD	r_1	r_2
Age (years)	21.66	3.08	0.18**	-.014
Education (years)	12.35	0.92	0.25**	0.18**

**Significant at the .01 level

TABLE 1a

Cross-Validation Sample
N=322

	Mean	SD	r
Age (years)	23.1	4.3	-.059
Education (years)	11.1	1.8	.315**
Experience (months)	31.9	16.6	.118*

*Significant at the .05 level
**Significant at the .01 level

ANALYSIS

The initial step in analysis is to identify those aptitudes which show some evidence of validity and job relatedness. This evidence can be:

1. Statistical evidence of the correlation with the criterion (r).
2. Content validity as evidenced by a rating of "critical" based on job analysis, or
3. Any combination of the following:

   --high mean

   --low standard deviation (SD)

   --rating of "important" based on job analysis

   --demonstrated validity in a prior validation study.

Statistical results for the validation sample are shown in Table 2.

TABLE 2

Statistical Results for Validation Sample
N=253

Aptitude	Mean	SD	r_1	r_2
G - General Learning Ability	102.1	16.2	.54**	.20**
V - Verbal Ability	96.9	13.2	.48**	.23**
N - Numerical Aptitude	100.1	16.4	.51**	.20**
S - Spatial Aptitude	110.2	18.5	.32**	.08
P - Form Perception	112.8	18.9	.25**	.20**
Q - Clerical Perception	112.2	14.0	.39**	.13*
K - Motor Coordination	102.4	16.1	.29**	.13*
F - Finger Dexterity	100.7	19.5	.24**	.14*
M - Manual Dexterity	113.9	20.7	.23**	.11

*Significant at the .05 level
**Significant at the .01 level

Table 3 summarizes the qualitative analysis and statistical results shown in Table 2 and shows the aptitudes considered for inclusion in the SATB.

TABLE 3

Summary of Qualitative and Quantitative Data
for Validation Sample

Type of Evidence	Aptitudes								
	G	V	N	S	P	Q	K	F	M
Job Analysis Ratings									
Critical									
Important	X		X	X	X				X
Irrelevant									
Statistical Evidence									
High Mean					X	X			X
Low SD		X				X			
Significant r									
Instructor Rating Criterion	X	X	X	X	X	X	X	X	X
Supervisor Rating Criterion	X	X	X		X	X	X	X	
Aptitudes Considered for Inclusion in the Battery	X	X	X	X	X	X	X	X	X

The information in Table 3 indicates that all nine aptitudes should be considered for inclusion in the battery. The objective is to develop a battery of 2, 3, or 4 aptitudes with cutting scores at the point (a) where about the same percent will meet the cutting scores as the percent placed in the high criterion group and (b) which will maximize the relationship between the battery and the criterion.

The cutting scores are set at approximately one standard deviation below the mean aptitude scores of the sample with deviations at five point intervals above and below these points to achieve the objectives indicated above.

The following battery resulted:

Aptitudes	Cutting Scores
V - Verbal Aptitude	90
P - Form Perception	95
M - Manual Dexterity	85

Although Aptitude V does not appear in the qualitative analysis, it is not contraindicated on the basis of the job description. Tasks requiring reading ability, e.g., reading of building codes, specifications, and safety codes are clearly stated in the job description.

The inclusion of Aptitudes P and M is amply justified by both qualitative and quantitative evidence.

VALIDITY OF THE BATTERY

Initially, this section of the report presents evidence of criterion-related validity of the SATB on the validation sample, all relevant subsamples and a cross-validation sample. Next, it provides information on effectiveness and fairness of the test norms. Another short presentation deals with the question

of whether prior batteries cross-validate on the validation sample. Finally, this section discusses incorporating the occupation into the Occupational Aptitude Pattern (OAP) structure.

Criterion Related Validity

Table 4 shows that there is a significant relationship between the job performance criteria and the current SATB for (a) the validation sample in aggregate, (b) identifiable ethnic subgroups of the validation sample, and (c) the cross-validation sample.

TABLE 4

Validity of Battery

Sample	N	High Criterion Group		Low Criterion Group		Chi Square	Significance level P/2<	Phi Coefficient
		Below Cutting Scores	Meeting Cutting Scores	Below Cutting Scores	Meeting Cutting Scores			
Validation Total	253	39	130	52	32	36.7	.0005	.38
Black	46	6	11	19	10	2.8	.05	.25
Non-minority	184	29	108	28	19	24.1	.0005	.36
Cross-validation	322	102	115	84	71	11.3	.0005	.19

As a further check of battery validity, a multiple correlation coefficient for the total validation sample was computed. An R of .33 (significant at the .005 level) was obtained between the dichotomized multiple-hurdle criterion and SATB Aptitudes V, P, and M.

Effectiveness of the Battery

The level of validity shown in Table 4 indicates that the SATB will be useful in selection. In the total validation sample, 67% were considered to be highly proficient. Of those who met the cutting scores, 80% were judged to be highly proficient, an increase of 13 percentage points over the existing selection method. Similar results were found for the cross-validation sample. These findings are shown in Table 5.

TABLE 5

Effectiveness of the Battery

Selection System	Number Selected	Highly Proficient (High criterion group)		Marginal (Low criterion group)	
		N	% of Total	N	% of Total
Validation Sample					
Without Tests	253	169	67%	84	33%
With Tests	162	130	80%	32	20%
Cross-validation Sample					
Without Tests	322	217	67%	105	33%
With Tests	149	115	77%	34	23%

Subgroup Analysis

No difference in the validities for Blacks and nonminorities was found for this battery; the difference between the phi coefficients for Blacks and nonminorities is not statistically significant (CR= -0.75).

The battery is fair to Blacks since the percent of both Blacks and nonminorities who met the cutting scores approximated the percent who were in the high criterion group; 46% of the Blacks met the cutting scores and 37% were in the high criterion group; 69% of the nonminorities met the cutting scores and 74% were in the high criterion group.

Prior Batteries

Cross-validity of prior test norms on the validation sample was checked. The most recent battery (S-61R), last validated in 1970, is N-85, S-80, Q-75, M-80. This battery cross-validates with the total validation sample. The old battery (B-304) validated in 1953-54, is G-85, N-80, S-80, M-80. This battery also cross-validates with the total validation sample.

Occupational Aptitude Pattern

This occupation was incorporated into OAP-36 in Section II of the 1970 edition of the Manual for the USES General Aptitude Test Battery with a double asterisk (**), because (1) the battery included two of the three aptitudes in the OAP, (2) the cutting scores of the two aptitudes are within ten points of the corresponding aptitudes in the OAP, and (3) a significant phi coefficient of .24 ($P/2 < .0005$) was obtained for this sample between the criterion and the OAP-36 cutting scores of N-85, P-95, and M-90.

APPENDIX 1

Descriptive Statistics for Black and Nonminority Subgroups of Validation Sample

	Nonminority (N=184)			Black (N=46)		
Variable	Mean	SD	Range	Mean	SD	Range
Aptitude G	105.1	15.5	61-157	89.2	11.9	56-113
Aptitude V	98.7	13.3	66-141	89.2	10.2	68-119
Aptitude N	102.7	15.8	57-143	89.8	14.1	48-111
Aptitude S	111.5	17.7	65-163	101.5	19.9	61-143
Aptitude P	115.0	18.2	75-167	100.9	17.1	49-133
Aptitude Q	113.6	14.4	79-165	105.6	11.2	84-128
Aptitude K	102.7	16.2	66-149	100.4	15.9	56-130
Aptitude F	101.6	19.1	53-180	95.2	19.3	44-133
Aptitude M	114.8	20.7	64-165	108.6	17.3	68-142
Criterion I	105.9	16.4	53-144	89.9	15.2	44-119
Criterion II	40.7	6.2	18-58	35.8	5.6	22-47
Age	21.4	3.1	17-34	22.5	2.8	18-29
Education	12.4	0.9	10-16	12.1	0.8	8-15

APPENDIX 2

U.S. DEPARTMENT OF LABOR • MANPOWER ADMINISTRATION

DESCRIPTIVE RATING SCALE

SCORE _____

RATING SCALE FOR _____

D.O.T. Title and Code

Directions: Please read the "Suggestions to Raters" and then fill in the items which follow. In making your ratings, only one box should be checked for each question.

SUGGESTIONS TO RATERS

We are asking you to rate the job performance of the people who work for you. These ratings will serve as a "yardstick" against which we can compare the test scores in this study. The ratings must give a true picture of each worker or this study will have very little value. You should try to give the most accurate ratings possible for each worker.

These ratings are strictly confidential and won't affect your workers in any way. Neither the ratings nor test scores of any workers will be shown to anybody in your company. We are interested only in "testing the tests." Ratings are needed only for those workers who are in the test study.

Workers who have not completed their training period, or who have not been on the job or under your supervision long enough for you to know how well they can perform this work should not be rated. Please inform the test technician about this if you are asked to rate any such workers.

Complete the last question only if the worker is no longer on the job.

In making ratings, don't let general impressions or some outstanding trait affect your judgment. Try to forget your personal feelings about the worker. Rate only on the work performed. Here are some more points which might help you:

1. Please read all directions and the rating scale thoroughly before rating.

2. For each question compare your workers with "workers-in-general" in this job. That is, compare your workers with other workers on this job that you have known. This is very important in small plants where there are only a few workers. We want the ratings to be based on the same standard in all the plants.

3. A suggested method is to rate all workers on one question at a time. The questions ask about different abilities of the workers. A worker may be good in one ability and poor in another—for example, a very slow worker may be accurate. So rate all workers on the first question, then rate all workers on the second question, and so on.

4. Practice and experience usually improve a worker's skill. However, one worker with six months' experience may be a better worker than another with six years' experience. Don't rate one worker as poorer than another merely because of a lesser amount of experience.

5. Rate the workers according to the work they have done over a period of several weeks or months. Don't rate just on the basis of one "good" day, or one "bad" day or some single incident. Think in terms of each worker's usual or typical performance.

6. Rate only the abilities listed on the rating sheet. Do not let factors such as cooperativeness, ability to get along with others, promptness and honesty influence your ratings. Although these aspects of a worker are important, they are of no value for this study as a "yardstick" against which to compare aptitude test scores.

MA 7-66
Apr. 1973

NAME OF WORKER (Print) (Last) (First)

SEX: MALE_____ FEMALE_____

Company Job Title: _____

How often do you see this worker in a work situation?

- ☐ All the time.
- ☐ Several times a day.
- ☐ Several times a week.
- ☐ Seldom.

How long have you worked with this worker?

- ☐ Under one month.
- ☐ One to two months.
- ☐ Three to five months.
- ☐ Six months or more.

A. How much can this worker get done? (Worker's ability to make efficient use of time and to work at high speed.) (If it is possible to rate only the quantity of work which a person can do on this job as adequate or inadequate, use #2 to indicate "inadequate" and #4 to indicate "adequate.")

- ☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.
- ☐ 2. Capable of low work output. Can perform at a slow pace.
- ☐ 3. Capable of fair work output. Can perform at an acceptable pace.
- ☐ 4. Capable of high work output. Can perform at a fast pace.
- ☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good is the quality of work? (Worker's ability to do high-grade work which meets quality standards.)

- ☐ 1. Performar is inferior and almost never meets minimum quality standards.
- ☐ 2. Performance is usually acceptable but somewhat inferior in quality.
- ☐ 3. Performance is acceptable but usually not superior in quality.
- ☐ 4. Performance is usually superior in quality.
- ☐ 5. Performance is almost always of the highest quality.

C. How accurate is the work? (Worker's ability to avoid making mistakes.)

- ☐ 1. Makes very many mistakes. Work needs constant checking.
- ☐ 2. Makes frequent mistakes. Work needs more checking than is desirable.
- ☐ 3. Makes mistakes occasionally. Work needs only normal checking.
- ☐ 4. Makes few mistakes. Work seldom needs checking.
- ☐ 5. Rarely makes a mistake. Work almost never needs checking.

MA 7-66
Apr. 1973

D. How much does the worker know about the job? (Worker's understanding of the principles, equipment, materials and methods that have to do directly or indirectly with the work.)

- ☐ 1. Has very limited knowledge. Does not know enough to do the job adequately.
- ☐ 2. Has little knowledge. Knows enough to get by.
- ☐ 3. Has moderate amount of knowledge. Knows enough to do fair work.
- ☐ 4. Has broad knowledge. Knows enough to do good work.
- ☐ 5. Has complete knowledge. Knows the job thoroughly.

E. How large a variety of job duties can the worker perform efficiently? (Worker's ability to handle several different operations.)

- ☐ 1. Cannot perform different operations adequately.
- ☐ 2. Can perform a limited number of different operations efficiently.
- ☐ 3. Can perform several different operations with reasonable efficiency.
- ☐ 4. Can perform many different operations efficiently.
- ☐ 5. Can perform an unusually large variety of different operations efficiently.

F. Considering all the factors already rated, and only these factors, how good is this worker? (Worker's all-around ability to do the job.)

- ☐ 1. Performance usually not acceptable.
- ☐ 2. Performance somewhat inferior.
- ☐ 3. A fairly proficient worker.
- ☐ 4. Performance usually superior.
- ☐ 5. An unusually competent worker.

Complete the following ONLY if the worker is no longer on the job.

G. What do you think is the reason this person left the job? (It is not necessary to show the official reason if you feel that there is another reason, as this form will not be shown to anybody in the company.)

- ☐ 1. Fired because of inability to do the job.
- ☐ 2. Quit, and I feel that it was because of difficulty doing the job.
- ☐ 3. Fired or laid off for reasons other than ability to do the job (i.e., absenteeism, reduction in force).
- ☐ 4. Quit, and I feel the reason for quitting was not related to ability to do the job.
- ☐ 5. Quit or was promoted or reassigned because the worker had learned the job well and wanted to advance.

RATED BY	TITLE	DATE
COMPANY OR ORGANIZATION	LOCATION (City, State, ZIP Code)	

GPO 693-714

MA 7-66
Apr. 1973

APPENDIX 3

DESCRIPTIVE RATING SCALE FOR APPRENTICES

Score _____

Rating Scale For _____
D.O.T. Title and Code

Directions: Please read the "Suggestions to Raters" and then fill in the items which follow. In making your ratings, only one box should be checked for each question.

SUGGESTIONS TO RATERS

We are asking you to rate the job performance of the apprentices whom you instructed. These ratings will serve as a "yardstick" against which we can compare the test scores in this study. The ratings must give a true-picture of each apprentice or this study will have very little value. You should strive to give the most accurate ratings possible for each apprentice.

These ratings are strictly confidential and won't affect your apprentices in any way. Neither the ratings nor test scores of any apprentice will be shown to anyone other than personnel conducting the study. We are interested in only "testing the tests." Ratings are needed for only those apprentices who are in the test study.

Please inform the individual who has given you this form to complete if you have not instructed any of the apprentices long enough for you to know how well they are performing. Such apprentices should not be rated.

Complete the last question on this form only if the apprentice did not complete the training.

In making ratings, don't let general impressions or some outstanding trait affect your judgment. Try to forget your personal feeling about the apprentice. Rate the person only on his performance. Here are some additional points which might help you:

1. Please read and study all directions and the rating scale thoroughly before rating an apprentice.

2. For each question compare your apprentices with "apprentices in general" for this type of training. We want the ratings to be based on the same standards in all training courses covering the same occupation.

3. A suggested method is to rate all apprentices on one question at a time. The questions pertain to the different abilities of the apprentices. An apprentice may be good in one ability and poor in another; for example, a very slow apprentice may be very accurate. So rate all apprentices on the first question, then rate all apprentices on the second question, and so on.

4. Rate the apprentices according to the work they have done throughout the entire training. Don't rate just on the basis of one "good" day, one "bad" day or some single incident. Think in terms of each apprentice's usual or typical day by day performance.

5. Rate only on the abilities listed on the rating sheet. Do not let factors such as cooperativeness, ability to get along with others, promptness and honesty influence your ratings. Although these aspects of an apprentice are important, they are of no value for this study as a "yardstick" against which to compare aptitude test scores.

A. How much ability does the apprentice have for maintaining adequate production in the vocational activity for which training was given. (If it is possible to rate only the quantity of work which an apprentice can do as adequate or inadequate, use #2 to indicate "inadequate" and #4 to indicate "adequate."

- ☐ 1. Capable of very low work output. Can perform only at an unsatisfactory pace.
- ☐ 2. Capable of low work output. Can perform at a slow pace.
- ☐ 3. Capable of fair work output. Can perform at an acceptable pace.
- ☐ 4. Capable of high work output. Can perform at a fast pace.
- ☐ 5. Capable of very high work output. Can perform at an unusually fast pace.

B. How good was the quality of the apprentice's work during the vocational training?

- ☐ 1. Performance was inferior and almost never met minimum quality.
- ☐ 2. Performance was usually acceptable but somewhat inferior in quality.
- ☐ 3. Performance was acceptable but usually not superior in quality.
- ☐ 4. Performance was usually superior in quality.
- ☐ 5. Performance was almost always of the highest quality.

C. How quickly did the apprentice learn the instructional units of the vocational training?

- [ ] 1. Learned the work very slowly. Needed careful and repeated instructions.
- [ ] 2. Learned the work somewhat slower than most.
- [ ] 3. Learned most of the work in the usual amount of time.
- [ ] 4. Learned most of the work quickly.
- [ ] 5. Learned all of the work rapidly. Needed only the minimum amount of training or instructions for even the difficult aspects.

D. How well did the apprentice use the equipment in training?

- [ ] 1. Could not use the equipment adequately.
- [ ] 2. Used the equipment well enough to "get by."
- [ ] 3. Used the equipment well enough to do fair work.
- [ ] 4. Used the equipment to do good work.
- [ ] 5. Used the equipment to do excellent work.

E. How large a variety of job duties can the apprentice perform efficiently?

- ☐ 1. Cannot perform different operations adequately.
- ☐ 2. Can perform a limited number of different operations efficiently.
- ☐ 3. Can perform several different operations with reasonable efficiency.
- ☐ 4. Can perform many different operations efficiently.
- ☐ 5. Can perform an unusually large variety of different operations efficiently.

F. Considering all the factors already rated, and only these factors, how acceptable was the apprentice's performance during training?

- ☐ 1. Performance was unsatisfactory.
- ☐ 2. Performance was not completely satisfactory.
- ☐ 3. Performance was satisfactory.
- ☐ 4. Performance was good.
- ☐ 5. Performance was outstanding.

Complete the last question only if the apprentice did not complete the training.

G. What do you think is the reason this person left the training? (It is not necessary to show the official reason if you feel there is another reason, as this form will not be shown to anyone except the personnel conducting the research.)

☐ 1. The apprentice left or was asked to leave because of inability to do the course work.

☐ 2. The apprentice left and I feel it was because he could not do the course work.

☐ 3. The apprentice left or was asked to leave for reasons other than the inability to do the course work. (Absenteeism, personal or family problems, etc.)

☐ 4. The apprentice left to take advantage of a better opportunity.

APPENDIX 4

JOB DESCRIPTION

Job Title:

Plumber (const.) 862.381-030
Pipe Fitter (const.) 862.381-018

Job Summary:

Lays out, fabricates, assembles, installs, alters, repairs and maintains all piping, fittings, valves, controls, fixtures, appliances, accessories, appurtenances, hangers, and supports for piping system such as those systems used for energy conversion and power generating facilities, heating, cooling, refrigerating, potable water supply, storm drainage, sanitary and industrial drainage, industrial production, environmental control, or any other piping system which conveys any fluid, liquid, vapor, gas, pulverized solid, or vacuum used in any domestic, commercial, industrial, institutional or governmental installation. Installs all piping systems according to governmental requirements, local codes, and job specifications based on a study of building plans and working drawings.

Work Performed:

Reads and interprets blueprints, building plans, job specifications and local codes to determine tools, materials and equipment needed to accomplish the job and to determine the pipe system location.

Locates and marks position of pipes, fittings, valves, controls, fixtures, appliances, accessories, appurtenances, hangers, and supports and any holes or channels necessary to accommodate the above with the use of steel tape, rule, level, plumb bob, building-level transit and laser beam.

*Cuts openings in walls, floors, and ceilings to accommodate piping systems using hand, power and power-actuated tools.

*Cuts pipe of all metallic and nonmetallic materials using hand and power operated cutters, cutting torch or hammer and chisel.

Bends pipe by hand or with mechanically, electrically, or hydraulically operated bending equipment.

*Fabricates and installs all piping including, but not limited to, brass, copper, lead, steel, glass, plastics, fiberglass, bituminous fiber, tile, ceramics, concrete and clay.

*Joins all of the above piping by means of threaded, calked, wiped, soldered, brazed, welded, fused, mechanical, glued, cemented, or chemically bonded joints.

*Installs drains, vents, supplies, circulators, balancers and roof flashings. Selects all traps and related connections for sanitary water supply and drainage.

*Installs all traps and related connections for sanitary water supply and drainage.

Installs energy conversion and power generating facilities, heating, air conditioning, cooling and refrigeration systems including compressors, pumps, meters, controls, mechanical equipment, pipe, pipe supports and pipe fittings.

*Extends and connects pipe lines to designated fixtures, appliances and mechanical equipment.

Fills piping system with water, air or appropriate gas or liquid for testing purposes in designated location for specific use.

*Repairs, replaces, alters, and maintains all piping, fixtures, appliances, accessories, and mechanical equipment in the above systems by using hand, power and hydraulically operated tools.

*Performs all of the above work in a safe manner as determined by the Occupational Safety and Health Act of 1970.

*Critical Job Duties. These job duties were designated as critical job duties because they must be performed competently if the job is to be performed in a satisfactory manner. Plumber/Pipe Fitter apprentices spend about 90% of their working time performing these duties.

APPENDIX 5

First Year Curriculum for Plumber/Pipe Fitter Apprentices

216 Hours

A. Safety

1. Accident Prevention I - Developing the safe working attitude. (One test)

2. Accident Prevention II - Defining and recognizing unsafe working practices and conditions. (One test)

B. Mathematics

1. Mathematics I - A review of basic math processes. (One test)

2. Mathematics II - The formulas, tables, and graphs used to solve problems encountered by the craftsman in his work. (One test)

3. Mathematics III - The application of basic math principles to pipe measurements and simple layout. (One test)

C. Drawing Interpretation

1. Drawing I Interpretation of technical (3 view) drawings as they relate to general piping, fixtures, and appliances. (One test)

2. Drawing II - Interpretation of piping isometric drawings and their use in piping design and layout. (One test)

3. Drawing III - Interpretation of building plans and their use in locating piping and piping systems within the building. (One test)

D. Use and Care of Tools

Safety procedures and proper uses of hand and power operated piping tools and equipment. (Two tests)

E. Soldering and Brazing

1. Safety procedures and preparation of tools, material, and equipment for the soldering and brazing of nonferrous pipe joints. (One test)

2. Soldering, brazing, and testing of nonferrous pipe joints. (One test)

F. Oxyacetylene Cutting and Welding

1. Safety procedures and preparation of tools, material, and equipment for the welding of flat metal and pipe. (One test)

2. Safety procedures and preparation of tools, material, and equipment for the layout, cutting, assembling, and welding of pipe. (One test)

3. Safety procedures and preparation of tools, material, and equipment for the layout, cutting, assembling, and welding of pipe in various positions. (One test)

Note: A-C are related theory courses. D-F are related practical (manipulative) courses.

*U.S. GOVERNMENT PRINTING OFFICE : 1970 O-724-257 1343